TABLE 2.—*Total number of days with thunderstorms in each month for the seven-year period, 1917–1923, inclusive, at the following stations in Alaska*

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Akiak						4		1					5
Akulurak						1	3		1				5
Allakaket						[a] 5	2	5					12
Anchorage						2	1						3
Annex Creek								2					2
Aniak								1					1
Attu	([b])												
Barrow							[a] 1	1					2
Calder											1		1
Camp No. 6									1				1
Candle						3		1					4
Chickaloon							1						1
Chicken						1	3						4
Chitina				1		1	1						3
Claim No. 2						1	1	1					3
Copper Center							1						1
Cordova									4				4
Council								1					1
Crooked Creek						1	3	1					5
Dawson						4	3						7
Dillingham							2						2
Eagle						[a] 15	9	2	1				27
Fairbanks					2	2	2	4					10
Fortman Hatchery						1		1					2
Fort Yukon						4							4
Goodnews Bay							1						1
Healy						2	3						5
Holy cross						3	2	1					6
Hydaburg				1									1
Indian River							1	1					2
Igloo								1					1
Juneau								1	1				2
Kake						1							1
Katalla										5	1		6
Kennecott							2						2
Matanuska						1							1
McKinley Park					1								1
Nakat					1								1
Naknek							1						1
Nenana						2	2	3					7
Nome						1		1					2
Noorvck					1	6	2	2					11
Nulato					3	3	5	4					15
Paxson							1						1
Peril Strait									1				1
Rampart					[a] 1	5	5	2					13
Richardson					2	1							3
Ruby							[a c] 1						1
Salcha						1							1
Salmon River					2	2	[a] 1	1					6
Seldovia							1						1
Seward		1						1	1	1	[d] 2		6
Sitka	1								3			1	5
St. Paul Island								1	1				2
Talkeetna						2	1	4	3				10
Tanana					1	7	3	3	2				16
Valdez							1	1	1				3
Total	1	1	0	2	14	82	66	48	20	6	4	1	245

[a] One or more storms accompanied by hail.
[b] Lightning observed on Jan. 28, 1921.
[c] Buildings were struck by lightning on July 3, 1920.
[d] One of these storms (that of Nov. 7, 1918) was accompanied by "a blindingstorm."

THUNDERSTORMS IN OHIO DURING 1917[2]

By W. H. ALEXANDER, C. F. BROOKS, and G. H. BURNHAM

INTRODUCTION

The purposes of this study are—

to determine as far as possible the origin, the distribution, the number, the frequency, the extent, the attending phenomena, etc., of these storms, and, if possible, to trace the history of each individual thunderstorm that enters or originates in the State of Ohio during the year 1917.[3]

About 830 well-scattered observers were enlisted. The network, however, was too open in the rougher plateau of the southeastern half of Ohio. Each observer was instructed to report each occasion thunder was heard or distant lightning seen and to give, so far as possible, the times, occurrences, or other information desired, as follows:

Thunder—first, loudest, last, and frequency; movement of storm—direction from which it appeared to come, how it passed (whether overhead, or to either side), and the direction to which it went; rain or snow—beginning, ending, and amount; hail—beginning, ending, amount, size, and form; wind—direction before and after, direction and time of highest wind; heat lightning—direction, and time. Remarks were also asked for.

Most of the observers made careful returns, but irregularity in reporting, omissions of place names or the sort of time used, and failure to discriminate between neighboring storms greatly reduced the potential value of many. The times of first and last thunder, occurrences of hail and lightning strokes, were mapped first, then small maps were made for thunderstorm areas each day or half day. Later, all the data on the cards were transferred to large post office maps.

Only on 7 days were the storms general over the State, and on 11 over almost the whole State; on 23, half the State, or slightly more, was covered; and on 17, almost half. Thunderstorms occurred with considerable frequency in a winter of much zero weather, even at times when the surface temperature was near freezing. There were tornadoes in winter as well as in summer.

Quick, decided changes in the weather proved favorable for the genesis and growth of thunderstorms, while equable conditions and gradual changes were unfavor-

[2] A joint study by the United States Weather Bureau and Clark University, in which Alexander, with the aid of H. H. Martin, collected and partially mapped the data, and both Alexander and Brooks studied them. Detailed discussions with maps are on file at the United States Weather Bureau Library, Washington, D. C., and the Columbus, Ohio, office of the Weather Bureau. The original reports and maps are at Columbus. The following summary was prepared by Brooks, of Clark University.
[3] Alexander, W. H., Climat'l. Data, Ohio Sec., Dec., 1916, 21: 91.

able. Of the 37 instances of the passage of the squall-lines of Alberta lows considered, 35 produced thunderstorms in Ohio. The openness of Ohio both to warm, moist winds and to cold winds provides the opportunity for frequent overturnings sufficiently intense for making thunderstorms.

Thunderstorms relative to pressure systems.—The distribution of thunderstorms in time and space is merely an index to the distribution of conditions favoring the violent convection of large masses of warm, humid air.[4] Thunderstorms may be classified according to their mode of occurrence. Doctor Humphreys has suggested the following divisions:[5]

Thunderstorms produced in—

"*a.* Regions of high temperature and widely extended, nearly uniform pressure. [Commonly called 'local' or 'heat' thunderstorms.]

"*b.* The southeast quadrant, or less frequently, the southwest, of a regularly formed low, or typical cyclonic storm. [Commonly known as the 'cyclonic' thunderstorm.]

"*c.* The barometric valley between the branches of a distorted or V-shaped cyclonic isobar. . . . 'tornadic.'

"*d.* The region covered by low-pressure trough between adjacent high pressure areas . . . might be called the '*anticyclonic*' thunderstorm, or even the 'trough' storm.

"*e.* The boundary between warm and cold waves . . . one might call it the 'border' storm.

In attempting to apply this classification to the 165 morning weather maps of the days with thunderstorms in Ohio during 1917 a modification was found desirable. Humphreys's classes *c* and *d* are so nearly alike that no distinction was practicable. On only four days might it seem desirable to distinguish intense thunderstorms in a distorted, sharp trough or V from the ordinary trough type. On the other hand, a rather distinct occurrence of thunderstorms was noted toward the southeastern ends of some strong "steering lines". that is, on the eastern border of the southeastern quadrant of Lows. While such storms might be classified in Humphreys's group *b*, they are different in position from the usual "cyclonic" thunderstorms in that they mark the eastern boundary of a warm, moist wind rather than the western portion, as is usually the case with thunderstorms in cyclones. Consequently, these steering-line, or warm-front storms were kept distinct from the cyclonic.

In Table I, then, the thunderstorms were classified according to Humphreys's groups, except that the "trough" and "tornadic" (*c* and *d*) were merged, and warm-front storms separated from other "cyclonic" or SE. quadrant ones. For clarity Humphreys's "trough" and "tornadic" storms (*c* and *d*) are here designated as "N.-S. trough" and his "border" type (*e*) as "E.-W. trough," the two being distinguished by whether the axis of the trough was more N.-S. or E.-W. Though the processes forming thunderstorms in both types of trough are essentially the same, the results with respect to any place are quite different. The N.-S. troughs march across the country eastward and soon pass, but the E.-W. ones in their eastward progress merely bring a continuation of thunderstorms day and night to a locality in the trough.

Table I shows the natural summer-time preponderance of thunderstorms of all classes, especially of the local and cyclonic types. The N.-S. trough storms occurred almost as often in the colder months as in the warmer. The greatest contrasts of the colder season thus were almost as potent as the greater surface warmth of the warmer. The E.-W. trough thunderstorms were most frequent in late spring and early summer, since the formation of such troughs in the general region of which Ohio is a part occurs between the more or less permanent high pressure areas over the cold Great Lakes and Northeast at this season, and the western portion of the Atlantic subtropical High. The warm-front storms were distinguishable only in winter when well-developed cyclones occurred. Squall-line, or cold-front, storms usually followed in a few hours. Some of the summer thunderstorms classed as "local" probably correspond to this winter type.

DISTRIBUTION OF THUNDERSTORMS IN OHIO

Table I and Figure 1 show the number of thunderstorm days by months and the year in different sections of Ohio. Sections 1, 2, and 4 are plains of about 500-1,000 feet elevation, except for 10 or 15 miles overlap onto the plateau; while 3 and 5 mark the maturely dissected Allegheny Plateau ranging from 500 to 1,540 feet above sea level.

The preponderance of thunderstorms in south over north and west over east was not great in summer, for temperatures and moisture conditions over most of the State are very much alike at that season. In winter, however, the incidence of thunderstorms is appreciably greater in the southwestern half of the State than in the northeastern half. This seems to result from the warm, moist winds in winter coming from the southwest, and the cold, dry ones generally from the northwest. Thus there should be in the southwest the highest temperature and largest moisture content, and also the largest contrast between the warm wind and the oncoming cold one, conditions most favorable to thunderstorms.

The thunderstorms of 1917 follow closely the usual expectation of high incidence from May to August, with the peak in June. The earlier months of the year, part of the mild winter of 1916-17, had many more thunderstorms than the last two months, at the onset of the very cold winter of 1917-18. The year as a whole was unusually thundery. From April 17 to September 7 there were but 22 out of the 144 days without reported thunderstorms.

DIURNAL INCIDENCE OF THUNDERSTORMS [6]

Table II shows that in winter there were more thunderstorms by night than by day and more in the early than in the late half of the night. Winter thunderstorms are the result of the development of excessive lapse rates owing to over and under running winds. At night when there is no solar heating in progress there is a minimum of friction with the ground, and therefore a maximum of opportunity for the unobstructed flow of warm, moist air at a moderate elevation. The cloud sheet at the top of such a flow of warm air may be in part responsible for thunderstorms at night, for it protects the warm layer of air against much loss of heat by radiation upward. The slight excess of the first over the last half of the night may be attributable to the observers sleeping more in the latter half.

In spring and autumn, the dominance of cyclonic conditions in producing thunderstorms is in evidence in

[4] Cf. W. M. Davis, Elementary Meteorology, 1894; W. J. Humphreys, Physics of the Air, 1920; and C. F. Brooks, The local, or heat, thunderstorm, MO. WEATHER REV., June, 1922, 50:281-284.

[5] Loc. cit., pp. 331-350, maps.

[6] Cf. J. v. Hann, Neue Beiträge zur Kenntnis der Täglichen Periode der Gewitter, *Met. Zeitschr.*, Feb., 1915, 32:73-82, 4 figs.

the rather even distribution throughout the quarters of the day, though the importance of daytime heating appears in the afternoon and evening maximum and the morning minimum.

Early summer brings a great increase in thunderstorms, and a great preponderance of afternoon and evening thunderstorms, these occurring on practically three-fourths of all days with thunderstorms. The formation of thunderstorms by cyclonic action becomes relatively less important. The period from midnight to 6 a. m. has the least of any quarter of the day. Of the different types, the sunny, local thunderstorms naturally show the greatest response to daytime heating, and the cloudy, E.-W. trough ones the least.

Cyclonic and trough thunderstorms in summer are in many instances really indistinguishable from local thunderstorms. They are classified according to the presence or lack of a definite low-pressure area evidently dominating the situation. As more thunderstorms occur in clear, quiet weather when general conditions are favorable than in partly cloudy, windy weather, the percentages shown in the table are made up mostly of storms occurring in weak cyclones, and so those scarcely distinguishable from local thunderstorms.

It is not surprising, therefore, that storms occur after noon on about four-fifths of the days with storms of the cyclonic type.

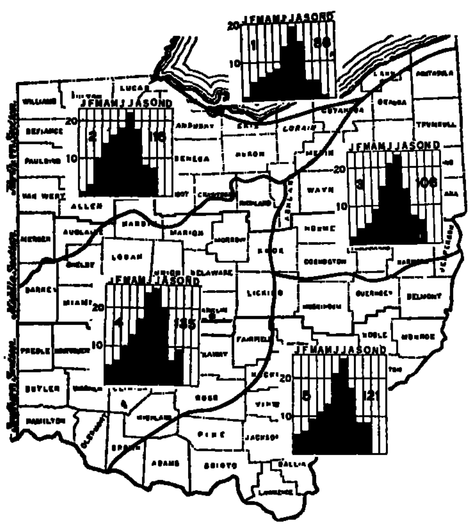


FIG. 1.—Monthly and annual incidence of thunderstorms in 1917, by geographic divisions

In May and June, 1917, there was a considerable prevalence of E.-W. troughs, with long periods of cool, cloudy weather. Under these circumstances, the E.-W. trough thunderstorms showed the same lack of diurnal variation found in cooler months, though, as with the cyclonic and local types the first quarter of the day was the least stormy.

From July to September, 1917, ordinary summer weather prevailed. Local thunderstorms were distributed about as in early summer, except that more began before noon. On 30 per cent of the days with heat thunderstorms such early starts occurred, as compared with but 10 per cent in May and June. With E.-W. troughs less pronounced than in May and June, the diurnal heating had a greater effect on the incidence of thunderstorms. They occurred in the afternoon on three-fourths of the days having the E.-W. trough type. In general, four-fifths of the storms occurring any time in the afternoon were in existence during each of the periods 2–4 p. m. and 4–6 p. m.

THUNDERSTORM MOVEMENTS—PROGRESS AND GROWTH

Thunderstorms, as is well known, move with a direction and speed which are the average for the winds affecting the main body of the cloud. But these may not be the same for all stages of growth. A storm in its youth may occupy a smaller vertical extent than in its maturity; therefore, if it formed in a moderately shallow easterly wind, then grew up into a westerly one above, the thunderstorm might move first from the east and then from the west. Even if the progressive movement does not change, the more or less irregular expansive growth characteristic of thunderstorms often makes them appear to take erratic strides. The front usually advances faster than the middle, and, when the movement is slow, the rear may grow so rapidly as to make the storm "return" to a place already passed.

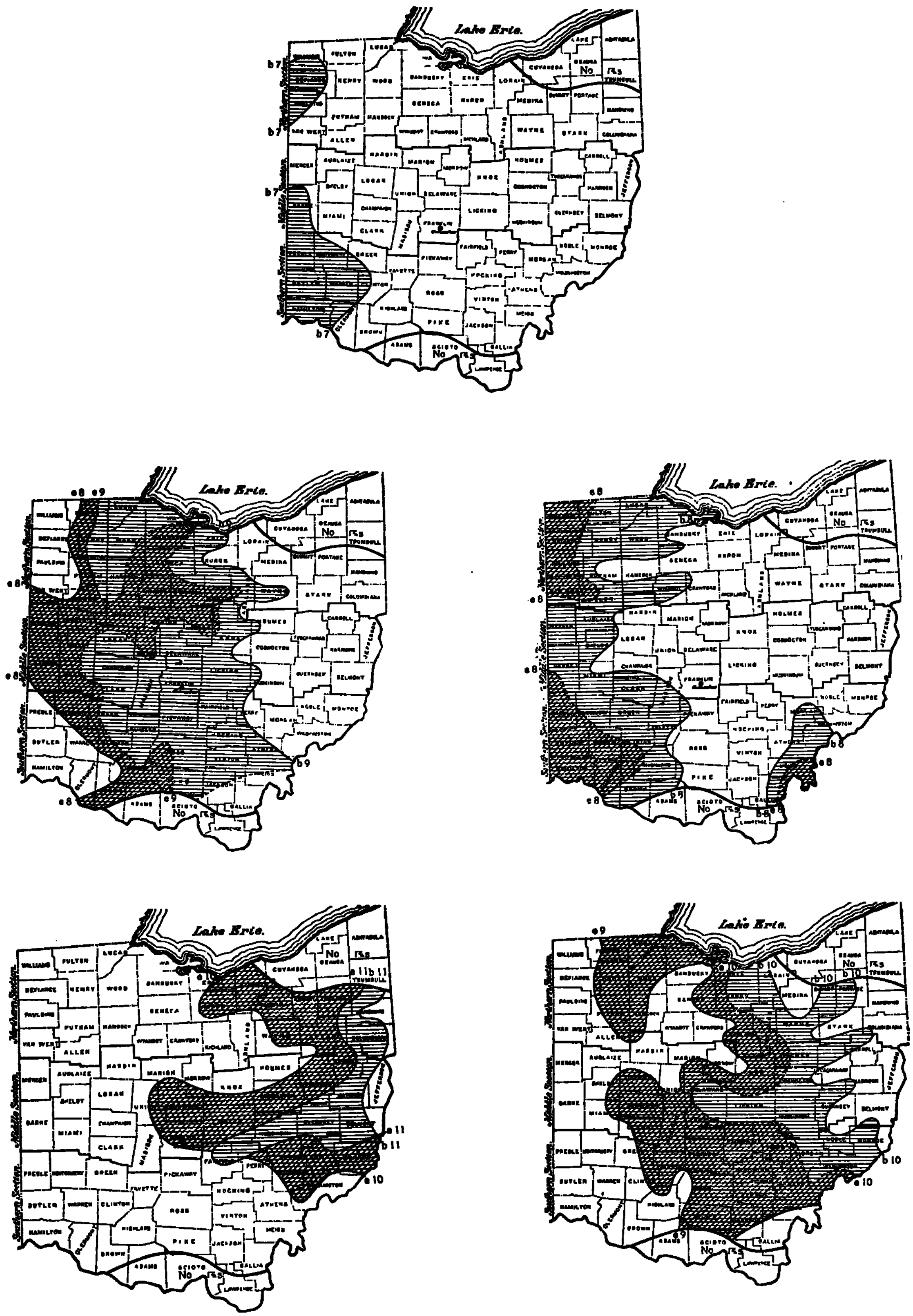
When a storm is developing, the increasing number and intensity of its crashes of thunder result in a very rapid advance of the zones of audibility. Thus, a new storm, if plotted by the time of first thunder, may advance, for a time, much more rapidly than its actual motion; while a dying one might hardly be heard before arrival. The use of thunderstorm rain-fronts in plotting thus has an obvious advantage.

FIG. 2.—Isobronts—first thunder in a warm-front group of storms, February 23, 1917, a. m. The marked irregularities are owing mostly to the local formations of storm in a general belt

With cyclonic thunderstorms, the general zone or zones in which thunderstorms occur moves at a speed the same as or somewhat greater than that of the low center. Individual storms, however, in such zones commonly move slantwise across the zone and at a greater speed than its progress. In the eastward moving squall-line of an intense low the thunderstorms are likely to travel at high speeds from the southwest. With old storms tending to run ahead of the general zone, and with new ones continually forming and expanding in several directions the system of thunderstorms becomes highly complex, and the thunder front and rear very irregular. (See figs. 2 and 3.)

SUGGESTIONS FOR FURTHER STUDY OF THE OHIO MAPS

In discussing the indications of the maps and preparing the tables we have scarcely made more than a general survey. The maps might be approached again with such questions as: The relations between individual and group thunderstorm movements and those of lows;



FIGS. 3–7.—Hourly progress of thunderstorm belt on rapidly moving warm front, March 23, 1917, 8 a. m. Lines marked "b7," "b8," etc., show where thunder began at 7 a. m., 8 a. m., etc., while "e8," "e9," etc., indicate where thunder ended at 8, 9, etc. (By H. H. Martin.)

the growth and decay of particular storms; the local incidence of thunderstorms, including their splittings and mergings and tendencies to follow topographic features, and the bi-hourly distribution by types, by sections, and by seasons. Unfortunately, the data are not adequate for the pursuing of such studies far, for the reports of neighboring observers are often difficult, if not impossible, to coordinate, and locations sometimes uncertain owing to stations being too far apart; generalizations of several small storms into one report; inaccuracies of 5, 10, or 15 minutes in time reporting; even uncertainties of an hour in the time used, and sometimes a question as to the date given.

With the use of data not mapped other research could be attempted. The automatic records at the several regular Weather Bureau stations in Ohio and near by, including the aerological observations at Royal Center, Ind., might be studied in detail for important thunderstorm days, and the sequence of events at the several stations coordinated. In this way, the causes of the thunderstorms, the distribution of which have been mapped, could be more definitely established than from the mere comparison of the thunderstorm maps with the 7 a. m. weather maps. In such an investigation the 7 p. m. manuscript weather maps would also be helpful.

A study might well be made of the influence of the distribution of wet ground, maximum temperatures, and winds, on the incidence of local thunderstorms. This is suggested by the observation, made in Texas, of thunderstorms on alternate days. Similar alternations appear several times in Ohio July 7–25, 1917. After a thundershower, the air is relatively dry for a day or two, and the ground is kept relatively cool by evaporation. These conditions are adverse to thunderstorm formation.

CONCLUSION

Those who are familiar with the results of earlier investigations will have recognized in the information obtained from this Ohio study much that is merely confirmatory. It seems evident that new researches on thunderstorm problems should now be intensive, with the investigators instrumentally well equipped and making their studies on selected storms.

TABLE I.—*Geographic and seasonal incidence of thunderstorms in Ohio, 1917*

[Compiled by G. H. B.]

	1. Local	2. Cyclonic	3. N.-S. trough	4. E.-W. trough	5. Steer. line	Total
Section 1, Lake Shore. (See Fig. 1):						
January	0	1	0	0	0	1
February	0	2	0	0	3	5
March	0	2	3	2	0	6
April	0	1	3	3	0	7
May	0	1	1	6	1	8
June	2	7	1	5	0	14
July	8	3	4	5	0	19
August	1	2	6	6	0	15
September	0	2	0	3	0	5
October	0	1	3	0	1	5
November	0	1	0	0	0	1
December	0	0	0	0	1	0
Year	11	23	21	30	5	86
Section 2, Northwest. (See Fig. 1):						
January	0	1	0	0	0	1
February	0	1	1	0	3	3
March	0	2	5	3	2	10
April	0	2	5	7	1	14
May	0	4	1	9	2	16
June	3	8	1	8	1	18
July	10	5	4	5	0	22

TABLE I.—*Geographic and seasonal incidence of thunderstorms in Ohio, 1917*—Continued

	1. Local	2. Cyclonic	3. N.-S. trough	4. E.-W. trough	5. Steer. line	Total
Section 2, Northwest—Con.						
August	1	2	7	7	0	17
September	0	3	2	5	0	8
October	0	3	3	0	1	7
November	0	0	0	0	0	0
December	0	0	0	0	0	0
Year	14	31	29	44	10	116
Section 3, Northeast. (See Fig. 1):						
January	0	2	0	0	0	2
February	0	2	2	0	2	4
March	0	0	3	3	0	5
April	0	2	4	3	1	9
May	0	4	1	10	2	15
June	4	11	2	8	1	21
July	9	4	5	5	0	23
August	1	2	4	7	0	14
September	1	3	0	3	0	7
October	0	3	2	0	1	6
November	0	0	0	0	0	0
December	0	0	0	0	0	0
Year	15	33	23	39	7	106
Section 4, Southwest. (See Fig. 1):						
January	0	2	0	0	4	5
February	0	3	3	0	2	6
March	0	1	6	3	2	10
April	0	4	4	5	1	13
May	0	4	1	10	4	17
June	4	13	2	10	1	24
July	12	5	4	5	0	25
August	4	2	6	8	0	20
September	1	1	1	5	0	6
October	0	4	3	7	1	9
November	0	0	0	0	0	0
December	0	0	0	0	0	0
Year	21	39	30	53	15	135
Section 5.—Southeast (see fig. 2.):						
January	0	1	0	0	4	5
February	0	1	4	0	2	6
March	0	0	6	2	2	9
April	0	3	4	5	2	11
May	0	4	1	8	4	13
June	2	11	2	9	1	21
July	9	7	5	5	0	25
August	3	1	6	7	0	17
September	0	1	0	6	0	6
October	0	4	8	1	1	8
November	0	0	0	0	0	0
December	0	0	0	0	0	0
Year	14	33	36	43	16	121
Ohio as a whole:						
January	0	2	0	0	4	5
February	0	4	4	0	4	9
March	0	2	6	3	2	10
April	0	5	5	7	1	17
May	0	6	1	15	4	21
June	5	12	2	11	1	27
July	12	7	5	6	0	26
August	5	2	8	9	0	24
September	1	4	3	6	0	12
October	0	8	.3	1	1	13
November	0	1	0	0	0	1
December	0	0	0	0	0	0
Year	23	54	37	58	17	165
Section 1	11	23	21	30	5	86
Section 2	14	31	29	44	10	116
Section 3	15	33	23	39	7	106
Section 4	21	39	30	53	15	135
Section 5	14	33	36	43	16	121
State	23	53	37	58	17	165

	Section 1	Section 2	Section 3	Section 4	Section 5	State
January	1	1	2	5	5	5
February	5	3	4	6	6	9
March	6	10	5	10	9	10
April	7	14	9	13	11	17
May	8	16	15	17	13	21
June	14	18	21	24	21	27
July	19	22	23	25	25	26
August	15	17	14	20	17	24
September	5	8	7	6	6	12
October	5	7	6	9	8	13
November	1	0	0	0	0	1
December	0	0	0	0	0	0
Year	86	116	106	135	121	165

TABLE II.—*Diurnal incidence of thunderstorms by quarters—Percentages of days with thunderstorms (T.) during which thunderstorms occurred in each quarter of the day*

[Compiled by C. F. B.]

Month and class	Section 1 (Lake)					Section 2 (NW.)					Section 3 (NE.)				
	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.
January and February:	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*
Cylonic and N.-S. trough	33	0	33	67	3	0	0	67	67	3	17	50	0	67	6
E.-W. trough and Warm-front	67	33	33	0	3	67	67	0	0	3	50	100	50	0	2
All	50	17	33	33	6	50	50	50	50	4	33	83	17	67	6
March, April, October, and November:															
Cylonic and N.-S. trough	36	29	50	57	14	16	32	58	47	19	23	38	77	31	13
E.-W. trough and Warm-front	38	13	50	75	8	43	29	71	50	14	50	38	63	63	8
All	42	26	58	74	19	29	32	68	52	31	35	40	75	45	20
Cooler months	44	24	52	64	25	31	34	66	51	35	35	50	61	50	26
May and June:															
Local	0	50	50	0	2	0	0	100	33	3	0	0	75	75	4
Cyclonic and N.-S. trough	30	20	70	90	10	7	43	93	79	14	28	16	89	72	18
E.-W. trough and Warm-front	36	36	55	73	11	33	48	57	62	21	30	55	60	55	20
All	32	32	64	77	22	24	44	82	74	34	30	39	86	75	36
July, August, and September:															
Local	0	11	89	44	9	0	36	82	82	11	0	27	91	64	11
Cyclonic and N.-S. trough	32	21	68	53	19	25	42	83	65	23	55	45	65	70	20
E.-W. trough and Warm-front	21	7	50	43	14	12	35	88	59	17	19	37	75	44	16
All	23	15	72	51	39	17	42	91	72	47	32	41	79	63	44
Warmer months	26	21	68	61	61	20	43	87	73	81	31	40	82	68	80
Year (1917)	31	22	64	61	86	23	40	81	66	116	32	42	77	64	106

Month and class	Section 4 (SW.)					Section 5 (SE.)					Average per cent all sections of Ohio				
	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.	12-6 a. m.	6 a. m.-12	12-6 p. m.	6 p. m.-12	T.
January and February:	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Days*
Cyclonic and N.-S. trough	25	25	38	50	8	33	50	33	50	6	22	25	34	60	10
E.-W. trough and Warm-front	67	33	0	33	6	67	33	0	33	6	64	53	17	13	6
All	45	36	27	55	11	55	45	18	45	11	47	46	29	50	14
March, April, October, and November:															
Cyclonic and N.-S. trough	43	38	52	52	21	50	39	39	39	18	34	35	55	45	27
E.-W. trough and Warm-front	46	46	54	69	13	55	36	36	55	11	46	32	55	62	15
All	47	42	56	63	32	41	30	30	36	36	39	34	57	54	41
Cooler months	47	42	49	60	43	45	34	28	38	47	40	37	51	53	55
May and June:															
Local	0	0	50	50	4	0	0	100	50	2	0	10	75	42	76
Cyclonic and N.-S. trough	30	25	80	70	20	33	28	83	78	18	26	26	83	78	21
E.-W. trough and Warm-front	58	46	54	54	24	67	67	57	38	21	45	50	57	56	29
All	50	38	78	73	40	59	56	85	68	34	39	42	79	73	48
July, August, and September:															
Local	0	35	88	53	17	0	42	100	33	12	0	30	90	55	18
Cyclonic and N.-S. trough	47	42	68	74	19	67	83	94	61	18	45	47	76	77	28
E.-W. trough and Warm-front	28	56	89	89	18	22	50	83	56	18	20	37	77	59	21
All	28	48	88	78	50	32	58	88	50	50	26	41	84	63	62
Warmer months	38	43	83	76	90	43	57	87	57	84	32	41	81	67	110
Year (1917)	40	43	72	70	133	43	49	65	50	131	34	39	72	62	165

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